The Present Application

When making high purity water and steam, dissolved atmospheric gases, such as nitrogen, oxygen, carbon dioxide, and argon, are contaminants. The presence of these contaminants create a number of drawbacks. First, at steam temperatures, some of these gases, such as the oxygen, are corrosive and can damage items which are sterilized with the steam, steam sterilization equipment, and other devices or materials that are subject to the product steam. Moreover, some of these gases can interact with other gases, water vapor, or contaminants on items to be treated with the steam to form other corrosive or detrimental radicals.

Second, the water vapor molecules in steam have a very high heat capacity as compared to nitrogen, oxygen, carbon dioxide, argon, or other atmospheric gases. When steam is diluted with these low heat capacity atmospheric gases, the steam delivers less heat per unit volume to items being sterilized or otherwise treated with the steam.

In the present application, the feed water with the dissolved atmospheric gases is sprayed over the upper ends of the vertical evaporator tubes or channels. The spray has a hit pattern which distributes the feed water uniformly over the vertical heat channels such that a film of water is formed flowing down the interior of each channel. Heat applied to the exterior of the channels vaporizes the film of feed water and discharges steam through the lower ends of the heat channels. The nozzles are configured not only to achieve an even hit pattern, but also to quickly separate the dissolved gases from the fine droplets. The dissolved gases are evacuated through outlets **5** and discarded. In this manner, the product steam discharged from the lower end of the vertical evaporation channels has a substantially lower, if any, content of atmospheric gases than the feed water.

The References of Record

None of the references relied upon by the Examiner either recognize the problem of dissolved atmospheric gases in the feed water nor teach or fairly suggest how to overcome this problem. First, "falling film evaporators" have a specific meaning in the art. See, for example, McCabe and Smith, "Unit Operations of Chemical Engineering", Third Edition, 1976, p. 433 (copy enclosed). Specifically, in falling film evaporators, the liquid enters at the top, flows downward inside the heated tubes as a film, and leaves from the bottom. The vapor evolved from the liquid is carried downward with the liquid and leaves from the bottom of the unit. In appearance, these evaporators resemble long, vertical tubular heat exchangers with a liquid-vapor separator at the bottom and a distributor of liquid at the top.

First, **El-Allawy** is not directed to a falling film evaporator. Second, El-Allawy does not recognize or address the problem of removing dissolved atmospheric gases from feed water. Third, the volatile hydrocarbons which El-Allawy does remove from the water are removed ***after*** the water has been passed through the boiler in a downstream separation process in separation chamber **22**. More specifically, the hydrocarbon and water components begin to separate in heat exchanger coil **16** where they begin to condense, but are actually separated in separation chamber **22** where the water condenses on the bottom and light hydrocarbons rise to the top and are withdrawn. A conventional degasser **9** removes the most volatile hydrocarbons upstream of the evaporator unit **14** and the spray nozzles **15**.

Because El-Allawy is not directed to falling film evaporators, does not recognize the dissolved atmospheric gas problem, and provides no solution to this problem, it is submitted that El-Allawy is not analogous prior art.

Blangetti discloses a process and device for preheating and deaerating make-up water in a power generation plant. This process involves a falling film evaporator **11** having a film generating device **20**. The spray device **24** is not situated at and does not spray the falling film tube inlets.

Rather, the spray device is disposed above a packed column **23**. According to Blangetti, deaeration of the feed water takes place all the way from spray device **24** to the bottom of section **14**. A counter-stream of steam and gas which initially forms at the bottom of section **14** flows back up around and through the device, ***mixed with any separated gases***, and eventually exiting at a top connection **26**. In this manner, any gas which may have separated during the preceding processing is recombined with the steam before it leaves the evaporator assembly. A condenser/stripper **3** condenses the steam back to liquid water **8** for recirculation while gases are drawn off by a suction device **27**.

Thus, the device of Blangetti is designed to produce boiler water and all steam leaving the falling film evaporator is at least as contaminated and diluted with atmospheric gases as the feed water supplied to the falling film evaporator. Note that only part of the water that entered the tubes is evaporated, the rest leaves as water. Thus, it is submitted that the product steam discharged at **26** has a ***higher*** concentration of dissolvable gases than the feed water.

Hohmann uses falling film evaporators in a process for concentrating a solution. Hohmann uses three falling film evaporators in series for progressively making the input liquid, particularly the black liquor produced in the production of paper pulp, more concentrated. The feed liquid is sprayed into the falling film evaporator forming condensate and vapor components in a steaming-out tank **7**. The more condensed condensate liquid is in part circulated in the same evaporator and in part forwarded to the next evaporator. The vapor from the steaming-out tanks of the last two evaporators is discharged through manifold **17**. The very-highly concentrated black liquor is withdrawn from the steaming-out tank of the last evaporator through line **20**. Hohmann is not concerned with removing dissolved gases from the feed liquid, provides no motivation to remove such gases, and provides no enabling disclosure of a means for doing so.

Ryham is directed to a falling film evaporator in which a chemically or otherwise contaminated water is heated to form water vapor which is discharged through port **18** and a more highly concentrated chemically-contaminated concentrate which is discharged through port **33**. Ryham is concerned and focuses on preventing water droplets containing the chemical contaminants from being carried through port **18** with the clean water vapor.

Ryham does not address and provides no motivation to remove dissolved gases from the feed water nor provides an enabling disclosure as to how such a separation could be achieved.

35 U.S.C. § 112

The applicants have amended claims 1-5 to address the issues noted by the Examiner. The applicants note that no 35 U.S.C. § 112 issues were raised by the Examiner regarding claims 6-10. It is requested that the Examiner either explain the 35 U.S.C. § 112 rejection of claims 6-10 or withdraw the rejection.

The Claims Distinguish Patentably Over the References of Record

First, **claim 1** calls for a method of feeding water to the heat transfer surfaces of a falling film evaporator having vertical evaporation channels. El-Allawy is not directed to a falling film evaporator or a method for using one.

Second, claim 1 further calls for spraying droplets of the feed water to upper ends of the heat transfer surfaces. El-Allawy makes no suggestion of spraying feed water droplets to the upper ends of the heat transfer surfaces of vertical evaporation tubes, nor does Biangetti spray the feed water on the upper ends of the heat transfer surfaces. Rather, Biangetti sprays the feed water onto packed column **23**.

Third, claim 1 calls for separating the water soluble atmospheric gases from the sprayed feed water. El-Allawy separates volatile hydrocarbons downstream in separator **22** and upstream in separator **9**, but does not separate at the spray.

Fourth, claim 1 calls for discharging the separated atmospheric gases separate from the vapor to reduce the atmospheric gas contamination of the vapor relative to the feed water. All gases and vapors in El-Allawy pass out line **18**. Thus, the vapor out has the same or possibly an even higher concentration of volatile hydrocarbons than the feed water in. Blangetti intermixes the separated gases and the steam prior to discharge. That is, both the steam and separated gases exit through line **26**. Thus, the generated steam has a comparable concentration of atmospheric gases as the inlet feed water. Of course, because the condensate **16** is not recombined with the separated atmospheric gas, the gas and vapor which is output through line **26** will have a ***higher*** gas concentration than the feed water.

Accordingly, it is submitted that **claim 1** distinguishes patentably and unobviously over El-Allawy, Blangetti, and the other references of record.

First, **claim 2** is directed to an apparatus for removing dissolved gases from water in connection with a falling film evaporator. El-Allawy does not disclose a falling film evaporator. Claim 2 also calls for vertical evaporating channels which convert the water to steam. El-Allawy does not disclose or suggest the use of vertical evaporating channels. To the contrary, El-Allawy teaches against falling film evaporator tubes in favor of direct spraying.

Second, claim 2 calls for a spraying device which sprays droplets into a pattern corresponding to an area of the upper end of the evaporator channels. El-Allawy has no vertical evaporator channels on which to spray water. Blangetti teaches against spraying feed water on upper ends of evaporator channels and instead requires the water to be sprayed onto a packed column **23**. That is, Blangetti teaches against spraying the feed water onto the vertical evaporator channels upper ends.

Third, claim 2 calls for at least one outlet for removing gases separated from the spray droplets prior to the droplets entering the evaporator channel to reduce dissolved gas contamination in the water vapor. El-Allawy removes steam and

vapor products together through a common outlet **18**. Blangetti similarly removes steam and other gases together through output channel **26**. Moreover, because both El-Allawy and Blangetti remove some condensate with reduced gas content directly, the output steam has a higher concentration of gases than the input feed water.

Accordingly, it is submitted that **claim 2 and claims 3-5 dependent therefrom** distinguish patentably and unobviously over the references of record.

Claim 3 calls for an outlet for the removal of gases separated from the sprayed droplets prior to the droplets entering the evaporator channels. Neither Hohmann nor Ryham have a gas outlet which removes separated gases prior to the water entering the evaporator channels. Entrance space **2** of Hohmann has several entrances for introducing feed materials, but no outlets for removing gases. Similarly, dome-shaped cover **19** of Ryham houses a receive line **17**, but no outlet for separated gases. Accordingly, it is submitted that **claim 3 and claim 5 dependent therefrom** distinguish patentably and unobviously over the references of record.

Claim 6 calls for a method of feeding water to heat transfer surfaces of a falling film evaporator. El-Allawy does not disclose or fairly suggest the use of a falling film evaporator. Further, claim 6 calls for simultaneously spraying the water over the upper ends of the vertical evaporation channels and separating atmospheric gases from the water. The atmospheric gases are discharged separately from the water vapor. By distinction, both Hohmann and Ryham have a common outlet at the lower end of the evaporation channels through which both water vapor and gases and other vapors are discharged. The atmospheric gas is not discharged separately from the water vapor. Indeed, neither Hohmann nor Ryham suggest or provide any motivation for removing atmospheric gases from feed water, much less disclosing a method for doing so. Hohmann is concerned with concentrating black liquor liquid. Ryham is concerned with concentrating chemically or otherwise contaminated water. Neither even addresses the issue of

separating atmospheric gases, much less provides any method for doing so. Accordingly, it is submitted that **claim 6 and claim 7 dependent therefrom** distinguish patentably and unobviously over Hohmann and Pyham.

First, **claim 8** is directed to an apparatus for removing dissolved atmospheric gases from water. By contrast, El-Allawy is directed to an apparatus for removing hydrocarbon contaminants from water.

Second, claim 8 calls for a falling film evaporator with vertical evaporating channels. El-Allawy has no such evaporating channels.

Further, claim 8 calls for a chamber which covers upper ends of the evaporating channel arrangement. El-Allawy has no evaporating tube arrangement for a chamber to cover the upper end thereof.

Moreover, claim 8 calls for an outlet in the chamber for dissolved gases to remove the dissolved gases before the water droplets enter the channels to generate the product vapor such that the product vapor has a lower concentration of atmospheric gases than the water. By contrast, El-Allawy and Blangetti discharge all gases and vapors through the self-same outlet as the steam such that the output steam has at least as great a concentration of these gases as the feed water.

Accordingly, it is submitted that **claim 8 and claims 9-10 dependent therefrom** distinguish patentably and unobviously over the references of record.

Claim 11 calls for a method of generating product steam which has a lower atmospheric gas concentration than the feed water from which it is generated. The atmospheric gases are discharged separately from the product steam. By contrast, El-Allawy and Blangetti discharge all gases and vapors through a common outlet **18, 26** while retaining some condensate liquid. In this manner, both generate an output steam product with at least as high or higher a concentration of atmospheric gases as the feed water.

Neither Hohmann nor Pyham have separate atmospheric gas and output steam outlets nor is either concerned with removing absorbed gases from feed water. Accordingly, it is submitted that **claim 11** distinguishes patentably and unobviously over the references of record.

Claim 12 is directed to an apparatus for generating steam with a lower concentration of atmospheric gases than the feed water. None of the references of record are concerned with the generation of product steam with a low concentration of absorbed gases. Hohmann and Fyham are both liquid concentrators and are not concerned with the production of steam without atmospheric gas decontamination. El-Allawy is concerned with separating hydrocarbon contaminants from water and is not concerned with the production of air-free steam. Blangetti is concerned with the generation of make-up water. To the extent that steam is generated as an intermediate step in the process, the generated steam is mixed with all of the removed dissolved gases, creating a vaporous mixture which is higher in dissolved gases than the original feed water (due to the condensate). An additional subsequent downstream apparatus is necessary to separate the water and the gases which is done by condensing the steam back into water. It is the liquid water which is the output product of Blangetti. Accordingly, it is submitted that claim 12 distinguishes patentably and unobviously over the references of record.

Formal Drawings

The application was filed with Formal Drawings. However, the Office Action contains no indication that the drawings are acceptable to either the Draftsman or the Examiner. An early indication that the Formal Drawings have been approved is requested.

CONCLUSION

For the reasons set forth above, it is submitted that claims 1-12 distinguish patentably and unobviously over the references of record. An early allowance of all claims is requested.

Respectfully submitted,

FAY, SHARPE, FAGAN,
MINNICH & McKEE, LLP

Thomas E. Kocovsky, Jr.
Reg. No. 28,383
1100 Superior Avenue
Seventh Floor
Cleveland, OH 44114-2518
(216) 861-5582

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:
M. SALMISUO

Serial No.: 09/8[illegible]1,213

Filed: May 3, 2001

For: **METHOD AND DEVICE FOR TREATING WATER FOR EVAPORATION**

Date of Last Office Action:
August 12, 2002

Attorney Docket No.:
MED 2 1233 US

Examiner: V. MANOHARAN

Art Unit: 1764

Confirmation: 2535

Cleveland, OH 44114
January 10, 2003

APPENDIX 1

A clean copy of all pending claims is as follows:

1. (Amended) A method of feeding water to the heat transfer surfaces of a falling film evaporator having vertical evaporation channels, which channels receive feed water at upper ends and discharge water vapor from lower ends, the method including:

distributing the feed water as a spray of drops to the upper ends of the heat transfer surfaces;

separating water soluble atmospheric gases from the sprayed feed water; and,

discharging the separated atmospheric gases separate from the steam to reduce atmospheric gas contamination of the water vapor relative to the feed water.

2. (Amended) An apparatus for removing dissolved gases from water to be evaporated in connection with a falling film evaporator, which apparatus comprises:

an arrangement of vertical evaporator channels which convert water passing therethrough into vapor;

at least one spraying device for breaking heated feed-water into a spray of droplets having a spray pattern substantially corresponding to an area of an upper end of the evaporator channel arrangement; and,

at least one separated gas outlet for the removal of gases separated from the sprayed droplets prior to the droplets entering the upper end of the evaporator channel arrangement reducing dissolved gas contamination of the vapor.

3. (Amended) An apparatus as defined in claim 2 further including:

a trough having a perforated bottom, the trough lying above the upper end of the evaporator channel arrangement.

4. (Twice Amended) The apparatus as defined in claim 2 further including:

a substantially hemispherical chamber covering the upper end of the evaporator channel arrangement such that the upper end of the evaporator channel arrangement forms a plane side of the hemispherical chamber; and,

the separated gas outlet being defined in the hemispherical chamber for removing the separated gases before they can enter the evaporator channel arrangement.

5. (Amended) The apparatus as defined in claim 3, further including:

a chamber covering the upper end of the evaporator channel arrangement, the separated gas outlet being defined in the chamber.

6. (Amended) A method of feeding water to heat transfer surfaces of a falling film evaporator having vertical evaporation channels, the method comprising:

spraying drops of water with absorbed atmospheric gases to distribute the water over the upper ends of the vertical evaporation channels;

simultaneously with the spraying, separating the atmospheric gases from the water;

evaporating the water in the vertical evaporation channels; and,

discharging the water vapor separately from the separated gases and maintaining the water vapor separate from

the separated gases to prevent dilution of the water vapor with the separated gases.

7. (Unamended) The method as defined in claim 6 further including:

collecting the sprayed droplets into a layer of water above the upper ends of the vertical evaporation channels;

separating additional atmospheric gases from the water layer;

feeding water from the water layer into the upper ends of the vertical evaporation channels.

8. (Amended) An apparatus for removing dissolved atmospheric gases from water, the apparatus comprising:

a falling film evaporator which includes a plurality of vertical evaporating channels, the vertical evaporating channels having upper ends arranged in an evaporator channel upper end arrangement for receiving water to be vaporized, product vapor exiting from a lower end of the channels;

a chamber covering the evaporator channel upper end arrangement;

at least one spraying device disposed in the chamber to break the water into a spray of droplets having a spray pattern which corresponds to an area of the vertical evaporating channel upper end arrangement; and

at least one dissolved gas outlet from the chamber for removal of the atmospheric gases separated from the water droplets during spraying before the water droplets enter the evaporating channels, such that the product vapor has a lower concentration of atmospheric gases than the water.

9. (Amended) The apparatus as set forth in claim 8 wherein the vertical evaporating channel upper end arrangement is confined to a circular area and further including a hemispherical chamber mounted to the vertical evaporating channel upper end arrangement.

10. (Amended) The apparatus as defined in claim 8 further including:

a perforated plate mounted in the chamber above and separated from the evaporator channel upper end arrangement, the spray of droplets being sprayed onto the plate, the water passing through perforations in the plate to the evaporator channel upper ends.

11. (New) A method of purifying water comprising:

spraying feed water for simultaneously (i) separating nitrogen, oxygen, carbon dioxide, and other dissolved water soluble atmospheric gases from the feed water, and (ii) distributing the feed water over upper ends of vertical evaporation tubes;

removing the separated nitrogen, oxygen, carbon dioxide, and other dissolved water soluble atmospheric gases from the sprayed feed water;

passing the sprayed feed water from which the water soluble atmospheric gases have been separated through the vertical evaporation channels and converting at least a portion of the feed water to steam; and,

discharging the steam separate from the separated nitrogen, oxygen, carbon dioxide, and other water soluble atmospheric gases separately from the steam such that the discharged steam has a lower concentration of nitrogen, oxygen, carbon dioxide, and other water soluble atmospheric gases than the feed water.

12. (New) An apparatus for generating steam with a reduced atmospheric gas content, the apparatus comprising:

a plurality of heated vertical evaporation tubes which receive liquid feed water at an upper end and discharge steam at a lower end;

a feed line for supplying feed water which contains dissolved water soluble atmospheric gases;

a means for distributing the feed water over upper ends of the vertical evaporation tubes and for liberating the dissolved water soluble atmospheric gases from the feed water

before the feed water enters the upper ends of the vertical evaporation tubes; and,

a means for removing the steam separate from the liberated water soluble atmospheric gases such that the product steam has a lower content of water soluble atmospheric gases than the feed water.